Remarks

Claims 1-29 are now pending in the present application. Claims 1-29 stand rejected. It is respectfully submitted that the pending claims define allowable subject matter.

Claims 1-21 have been provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1-29 of U.S. Patent 7,108,658 (hereinafter referred to as "the '658 Patent"). With respect to the double patenting rejections, Applicants submit that the pending Claims 1-21 define patentably distinct inventions as compared to Claims 1-29 of the '658 Patent. Notwithstanding, in the event that the sole remaining issue is the double patenting rejection, Applicants reserve the right and opportunity to submit a terminal disclaimer at such time.

Turning to remaining rejections, Claims 1, 2, 5, 6, 9, 10, 13, 14, 16-18, 23 and 25-29 are rejected under 35 USC § 103(a) as being unpatentable over Goto (U.S. Patent App. 2004/0165766) in view of Brandl (U.S. Patent 6,450,962) and Sumanaweera (U.S. Patent 7,037,263). Claims 3, 4, 7, 8, 11, 12, 15 and 19-22 are rejected under 35 USC § 103(a) as being unpatentable over Goto, Brandl, and Sumanaweera and further in view of Argiro (U.S. Patent 5,986,661). Applicants respectfully traverse these rejections for reasons set forth hereafter.

Claim 1 recites, in part, "identifying <u>a plane</u> within said volume data set, the plane having a thickness; processing said plane within said volume data set to form multiple enhanced images, the processing configurable to allow <u>processing in real-time while acquiring said ultrasonic volume data set</u> and configurable to allow processing after said ultrasonic volume data set is stored." Independent claim 9 recites, in part, "processing said data set within said plane with image enhancing techniques, the processing configurable to allow processing in real-time while acquiring said data set and configurable to allow processing after said data set is stored." Independent claim 17 recites, in part, "a processor for processing said series of adjacent scan planes, said processor identifying a plane having at least one thickness within said volumetric data set being transverse to said series of adjacent scan planes, said processor processing said plane with image enhancing techniques, said processor configured to process both in real-time while receiving said ultrasound signals and after said volumetric data set is stored."

As admitted in the Office Action, Goto does not disclose "identifying a plane within the volume, the plane having a thickness." The Office Action asserts that "it would be obvious to one skilled in the art that in order to process more quickly and efficiently, from a selected volume, a subvolume can be selected to be processed, such as disclosed by Brandl. The Office Action further asserts that "it would be obvious to have some sort of prescan in order to locate where exactly the observed object that is disclosed in Goto is located and then to narrow in one direction to quicken the processing time.

To support the pending rejection, the Office Action asserts on Page 3 that Brandl discloses choosing a particular subvolume such as particular organ or small tumor to be 3D rendered wherein the subvolume (rendering box) can be defined in size by a particular slice thickness and can be oriented in any direction." Applicant submits that the "rendering box" described by Brandl is NOT a plane within said volume data set, the plane having a thickness. Rather, Brandl describes and illustrates in Figure 2 that the rendering box 30 includes multiple scan planes 34. For example, Brandl explains that "[a] volume comprising multiple scan planes is output from the volume scan converter 42 and stored in the slice memory 44 as rendering box 30 (FIG. 2). The rendering box 30 in the slice memory 44 is formed from multiple adjacent image planes 34. Brandl does not state that the scan planes 34 have a thickness, rather Brandl states that "[t] he rendering box 30 may be defined in size by an operator to have a slice thickness 32, width 36 and height 38. The volume scan converter 42 may be controlled by the slice thickness control input 40 to adjust the thickness parameter of the slice to form a rendering box 30 of the desired thickness. The rendering box 30 designates the portion of the scanned volume 16 that is volume rendered. The volume rendering processor 46 accesses the slice memory 44 and renders along the thickness 32 of the rendering box 30." Brandl further explains that "[o]nce the rendering box 30 is placed over the scanned volume 16, the volume rendering processor 46 performs a projection operation through the rendering box 30 to combine voxels in adjacent image planes 34. The adjacent voxels are combined to form a single 2D rendered image." As explained by Brandl the size of the rendering box is controlled to designate the portion of the scanned volume to be volume rendered. Brandl does not describe identifying an image plane 34 in the volume rendering box 30 nor does Brandl describe that any of the image planes has a thickness. Moreover, Brandl does not describe that any of the image planes is first

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identified and then processed to form multiple enhanced images. Rather, Brandl clearly teaches the volume rendering processor 46 performs a projection operation through the rendering box 30 to combine voxels in adjacent image planes 34 to form a single 2D rendered image. Applicants therefore respectfully submit that Claim 1 is patentable over the combination of Goto and Brandl.

The Office Action further admits that Goto does not describe a processor that is configured to allow processing in real-time while acquiring the ultrasonic data. Applicant agrees. However, the Office Action now asserts that Sumanaweera makes up for this deficiency. Applicant disagrees.

As discussed previously, Goto is directed to processing a volume of data and displaying an image associated with the data. However, Goto is not able to process nor does Goto describe a processor configured to process both in real-time and after the acquired data is stored. Goto only discloses processing computed tomography (CT) data after the acquired data is stored. For example, Goto uses CT value counting memories, shown as MA on FIG. 1, for counting pixels that have a certain CT value or are within a range of CT values. Referring to FIG. 2A of Goto, "all the CT value counting memories MA1 to MAn are cleared in step 41, and a first projection line L1 is set in step 42." (Para. 46, lines 1-3). Pixel values associated with the projection line are read out and added to the appropriate counting memory. Then, in step 44, once all of the projection lines are completed, the process is complete. (Para. 48). Therefore, Goto determines the values of the pixels once and bases any and all subsequent processed images on this determination. Goto thus does not process any data in real-time.

Turning to Sumanaweera, the Office Action asserts that Sumanaweera describes "segmenting and providing enhanced filtering or processes based upon anatomical features such as blood, bone and tissue, in real-time showing that it is well known in the art to perform processing of various anatomical features in real time while acquiring ultrasonic images."

Initially, Applicants note that the Office Action fails to provide a single citation to Sumanaweera supporting this assertion. Additionally, Applicant notes that Claim 1, for example, recites in part "processing said plane within said volume data set to form multiple enhanced images, the processing configurable to allow processing in real-time while acquiring said

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ultrasonic volume data set and configurable to allow processing after said ultrasonic volume data set is stored." Applicant submits that Sumanaweera does not describe processing a plane within the volume data set to form multiple enhanced images, the processing configurable to allow processing in real-time while acquiring said ultrasonic volume data set. In contrast, Sumanaweera, like Goto, clearly describes that the volume data set is processed. For example, Sumanaweera states that "[w]hen the three-dimensional data set is repetitively updated in real time, such as associated with four-dimensional ultrasound imaging, the directional gradient may be recomputed each time the data set changes." Sumanaweera, like Goto, does not describe processing a plane within the volume data set while acquiring the volume data set. Because none of the cited art describes processing a plane within the volume data set, Claims 1, 9 and 17 are submitted to be patentable over the cited art. Claims 2, 5, 6, 10, 13, 14, 16, 18 and 23 depend from claims 1, 9, and 17 respectively. Therefore Claims 2, 5, 6, 10, 13, 14, 16, 18 and 23 are submitted to be patentable over the cited art.

The rejection of claims 3, 4, 7, 8, 11, 12, 15, and 19-22 as being unpatentable over Goto, Brandl, and Sumanaweera and further in view of Argiro (U.S. Patent 5,986,661) is respectfully traversed.

As discussed above, none of Goto, Brandl, and Sumanaweera describe processing a scan plane within a volume data set to form multiple enhanced images, the processing configurable to allow processing in real-time while acquiring said ultrasonic volume data set and configurable to allow processing after said ultrasonic volume data set is stored. Applicants further submit that Argiro also does not disclose at least processing in real-time while acquiring the data set or processing in real-time when receiving ultrasound signals. Instead, Argiro only processes data that has previously been acquired, such as on an Advanced Diagnostic Viewer (ADV), which is a three-dimensional medical imaging workstation (Col. 6, lines 18-21), or other three-dimensional graphics hardware. Argiro states that "[t]he ordering of the work flow permits a user to, inter alia, quickly retrieve data such as ultrasound, CT or MRI data over a network, such as that of a hospital." (Col. 7, lines 52-55). Therefore, it is submitted that Argiro does not make up for the deficiencies of Goto, Brandl and Sumanaweera. Therefore, Claims 1, 9 and 17 are patentable. Claims 3, 4, 7, 8, 11, 12, 15, and 19-22 depend from Claims 1, 9 and 17, respectively, and are therefore submitted to be patentable over the cited art.

Moreover, claim 8 recites "identifying thicknesses of said plane for each of said multiple enhanced images" and "wherein the processing said plane within said volume data set being based on said thicknesses, each of said multiple enhanced images being based on a different thickness." The Office Action admits on Page 4 that Goto only describes the use of ultrasound data. Applicants submit that Argiro fails to make up for the deficiencies of Goto with respect to the rejected claims. Specifically, Argiro adjusts the thickness of all of the displayed slices simultaneously, stating that "thickness slider 300 permits a user to enlarge the size of the slices shown in the MPR views of subwindows 310, 312 and 316" (Col. 23, lines 23-25). Therefore, Argiro is silent with respect to identifying a different thickness for each plane.

With respect to claim 12, claim 12 recites "identifying a depth based on said data set, said plane having different thicknesses based on at least one of said depth and said different image enhancing techniques." Dependent claim 19 recites "an input for identifying the plane within said volumetric data set; said processor identifying a depth based on said volumetric data set" and "at least one thickness control setting said at least one thickness based on at least one of said depth and said image enhancing techniques." Argiro, however, states that "[w]hen examination viewer component 114 is first entered from image gallery component 112, the MPR two-dimensional images automatically show the middle slice of the viewing orientation." (Col. 22, lines 44-47). Therefore, Argiro does not identify a depth based on the data set, but instead uses the same depth, the middle slice, for presenting all data sets. Also, as Argiro does not identify the depth, Argiro does not disclose the recitation of having different thicknesses based on at least one of said depth and said different image enhancing techniques nor the recitation of setting at least one thickness based on at least one of said depth and said image enhancing techniques.

Dependent claim 22 recites, in part, "said transducer further comprising having a transducer type, said processor further comprising identifying a subset of said image enhancing techniques based on said transducer type." Argiro is not concerned with a transducer type and does not disclose identifying a subset of said image enhancing techniques based on said transducer type. For at least the reasons stated above, Applicants submit that claims 3, 4, 7, 8, 11, 12, 15, and 19-22 are patentable over the cited art.

Applicants further submit that the dependent claims recite additional subject matter neither anticipated nor rendered obvious by the cited prior art. Moreover, the dependent claims are allowable based at least on the dependency of these claims from the independent claims.

In view of the foregoing comments, it is respectfully submitted that the cited references neither anticipate nor render obvious the claimed invention. Should anything remain in order to place the present application in condition for allowance, the Examiner is kindly invited to contact the undersigned at the telephone number listed below.

Respectfully Submitted,

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